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Welcome to Water Online's first dedicated E-Zine, "The Top 10 Trends of 2013," bringing you expert insight into the most important topics in the water and wastewater industry — direct to your computer, tablet, or smartphone. Beyond mere topic identification, however, our mission in assembling this unique collection of editorial content is to provide answers to the problems and questions you may have related to these trends.

In the following pages, we take aim at the 10 most buzzed-about topics in the industry today, according to user feedback and interest on Water Online:

- Energy Efficiency
- Advanced Metering Infrastructure
- Regulations
- Water Reuse
- Cybersecurity
- Infrastructure Repair
- Decentralization
- Water Scarcity
- Financing
- Emerging Contaminants

Say your utility is short on funds (whose isn't?) and long on expenditures (ditto). Our first trend piece, by Black & Veatch, describes how an energy service performance contract (ESPC) can free up those sorely needed funds. An ESPC cranks up energy efficiency by ratcheting down its use, resulting in more cash for infrastructure improvements, treatment upgrades, O&M costs, and everything else on your list. On page 8, the experts explain the ins and outs of the process.

Speaking of expenses, has the high capital cost of advanced metering infrastructure (AMI) implementation been keeping you at bay? Click through to page 12 to learn the pros, cons, and long-term financial impact of AMI from market research firm, Frost & Sullivan. It may very well change your mindset — and the future of your utility.

Click a little farther to get clarification and guidance on perhaps the most omnipresent (some might say overbearing) of all issues: government regulations. Love 'em or hate 'em, the U.S. Environmental Protection Agency (EPA) certainly keeps water and wastewater facilities on their toes. We keep you a step ahead by providing an overview of the recent and upcoming EPA mandates affecting water and wastewater on page 14.

Three articles in and you've already earned extra money for your facility, found a smart way to spend it, and mastered the EPA's key regulations!

Of course, that's a tongue-in-cheek way of saying that this magazine is designed to solve problems and inspire action — at your job, your utility, your business, or wherever your water concern lies. In reality, there are no quick fixes or easy applications, especially in the public sector. However, the 10 trends included here made the list for a reason: they are extremely relevant to the state of the industry now, and they point us in the right direction for years to come. If you browse the topics and one hits home, perhaps you have just found your solution. Moreover, the remaining trends and articles may inspire new ideas, sowing the seeds for future work. The beauty of this new format is that you can bookmark it, save it, or drop it in a folder, and then return to it for reference as situations arise.

In the coming months we will offer additional E-Zines, each with a different focus. Future editions will address specific technologies and areas of interest such as pumps, flow measurement, distribution, SCADA (supervisory control and data acquisition), water-quality analysis, and instrumentation, to name a few. What each E-Zine and article will have in common is a reliable perspective, because they are written by engineers, researchers, market analysts, and other trusted sources.

I encourage you to see for yourself and make good use of this, our inaugural E-Zine. If you would like to share feedback, story ideas, or become a contributor, please e-mail me at editor@wateronline.com.

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The Not-So-Risky Business Of Energy Savings Performance Contracts

Energy savings performance contracts enable public utilities to improve facilities and reduce costs in a way that minimizes financial risk.

By Fred Ellermeier and Peter Thomson

Water and wastewater treatment operations are estimated to use 3% of the total United States electrical consumption — more than 100 billion kilowatt-hours per year. Many utilities report that electrical power is not only their largest budget item, but also one of their fastest-rising costs. At the same time, utilities face significant strains on infrastructure and competition for their capital improvements budgets. Capital programs, regulatory burdens, rising costs, and rate issues compete for attention and create additional funding battles. Communities and utilities must make difficult choices about spending priorities.

Utilities that take a holistic look at actual long-term costs and evaluate projects as business cases, often can justify investments that address long-term issues. Investing now can provide paybacks either in reduced future costs (efficiency) or in renewal and replacement ahead of failure at a lower cost (avoided costs).

Concerns about financing infrastructure improvements and payback have led a small, but growing, number of utilities into energy savings performance contracts (ESPCs). Such contracts can help utilities reduce operating costs and make much-needed facility improvements in a way that eliminates potential concern about actual payback. The ESPC process identifies facility improvements that meet utility goals and make good business sense.

An ESPC offers multiple benefits. In this streamlined design-build approach to project delivery, an energy service company (ESCO) serves as the project developer. ESCO representatives work with utility staff to identify potential plant improvements that make financial sense. Examples of such improvements include installation of energy-efficient motors and lighting, upgrades in solids processing, and increased biogas and energy production. The ESCO then evaluates identified improvements to determine the most attractive

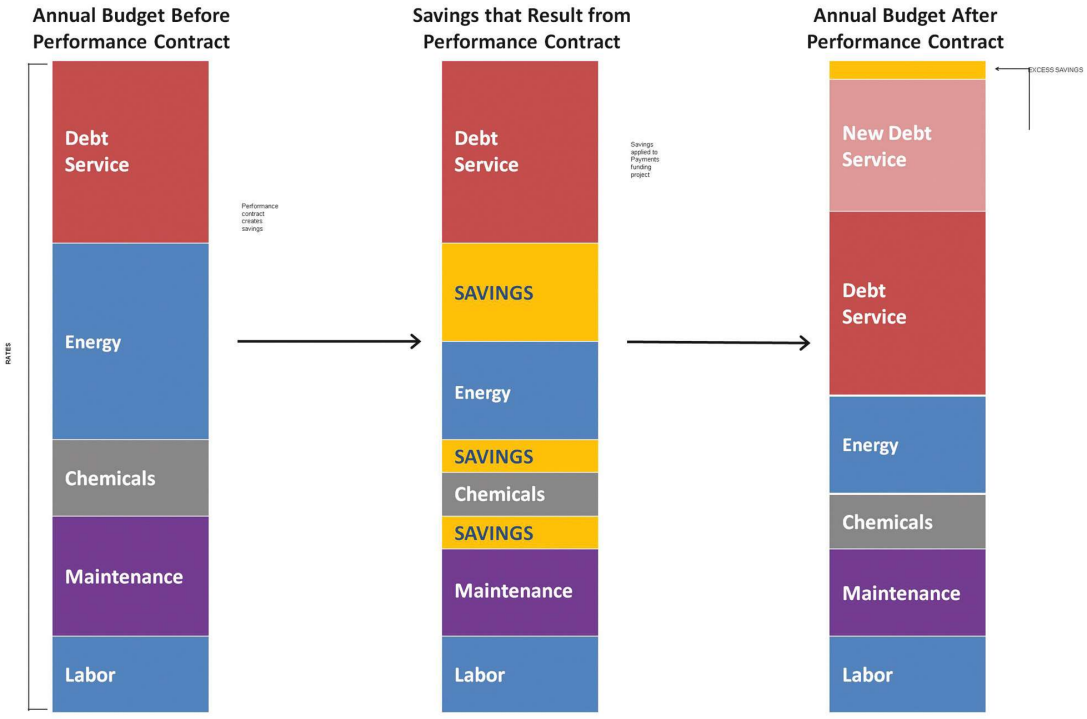
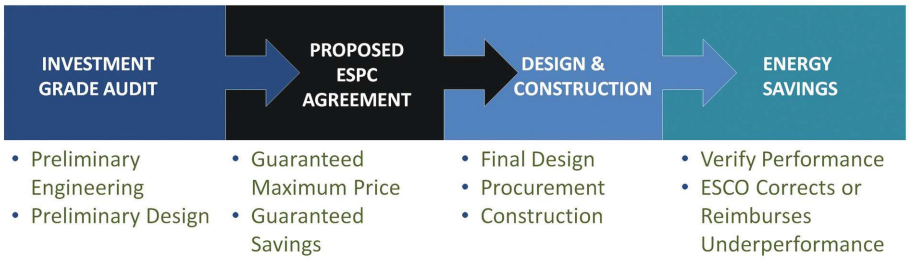


Figure 1 Turning O&M savings into capital funds.

Figure 2. The ESPC process, step by step.



projects and approach for implementation.

The ESPC approach includes a guarantee from the contracted energy service company that the project will result in a specified reduction in operations and maintenance (O&M) costs over a contracted guarantee term. Cost savings may result from reduced energy and chemical use and maintenance costs.

If the guaranteed savings are not realized as defined in the contract, the ESCO pays the utility the shortfall amount. The guaranteed O&M savings can be used to finance the capital project. Figure 1 shows how utilities can finance an efficiency project by shifting operational savings to debt service, with excess savings available for other uses.

The ESPC guarantee allows for greater flexibility in financing method, reduces risk to the wastewater utility, and can potentially reduce financing costs. It helps utilities secure financing, fund projects without up-front monies from capital budgets, and implement energy-saving capital projects at reduced risk.

If the guaranteed savings are not realized as defined in the contract, the ESCO pays the utility the shortfall amount.

The ESPC is a multistep process (Figure 2). It begins with a preliminary audit (planning level analysis), which typically leads to a contracted investment grade audit (IGA). The IGA identifies potential improvements and culminates in preliminary design and a proposal for implementation of identified energy conservation measures. The proposal includes a preliminary design of the energy conservation measures (ECMs), a detailed scope for final design and construction of the ECMs, a guaranteed maximum price for final design and construction, and performance guarantee stipulations.

If the utility accepts the proposal and hires the ESCO to move forward with implementation, there is no separate cost for the IGA, and the utility commits to pay the ESCO for the final design and construction. If the utility chooses not to accept the proposal and not move forward with the project, the utility is required to pay the ESCO a walk-away fee to compensate the company for performing the IGA. After construction and implementation of the ECMs, performance is monitored to verify savings. If the guaranteed savings are not achieved, the ESCO reimburses the utility for underperformance. As part of the process, the ESCO provides a turnkey service and is responsible for designing, implementing, and measuring the results of an energy performance contract.

Utilities also use energy performance contracting to achieve facility upgrades that they may not otherwise be able to justify. The ESCO can help utilities identify projects with rapid payback and then use the resulting savings to fund additional improvements with presumably lower or no payback.

Black & Veatch and an ESCO partner are currently assisting the Upper Occoquan Service Authority (UOSA) in Fairfax County, VA, with implementation of ECMs, including the installation of new biogas cogeneration facilities and replacement of two aeration blowers with high-speed turbo blowers to increase aeration efficiency. The ECMs were selected based on the owner's goal of being cash-flow positive from year one and achieving a maximum payback period of approximately 12 years. Preliminary estimates indicate potential annual savings of approximately $600,000.

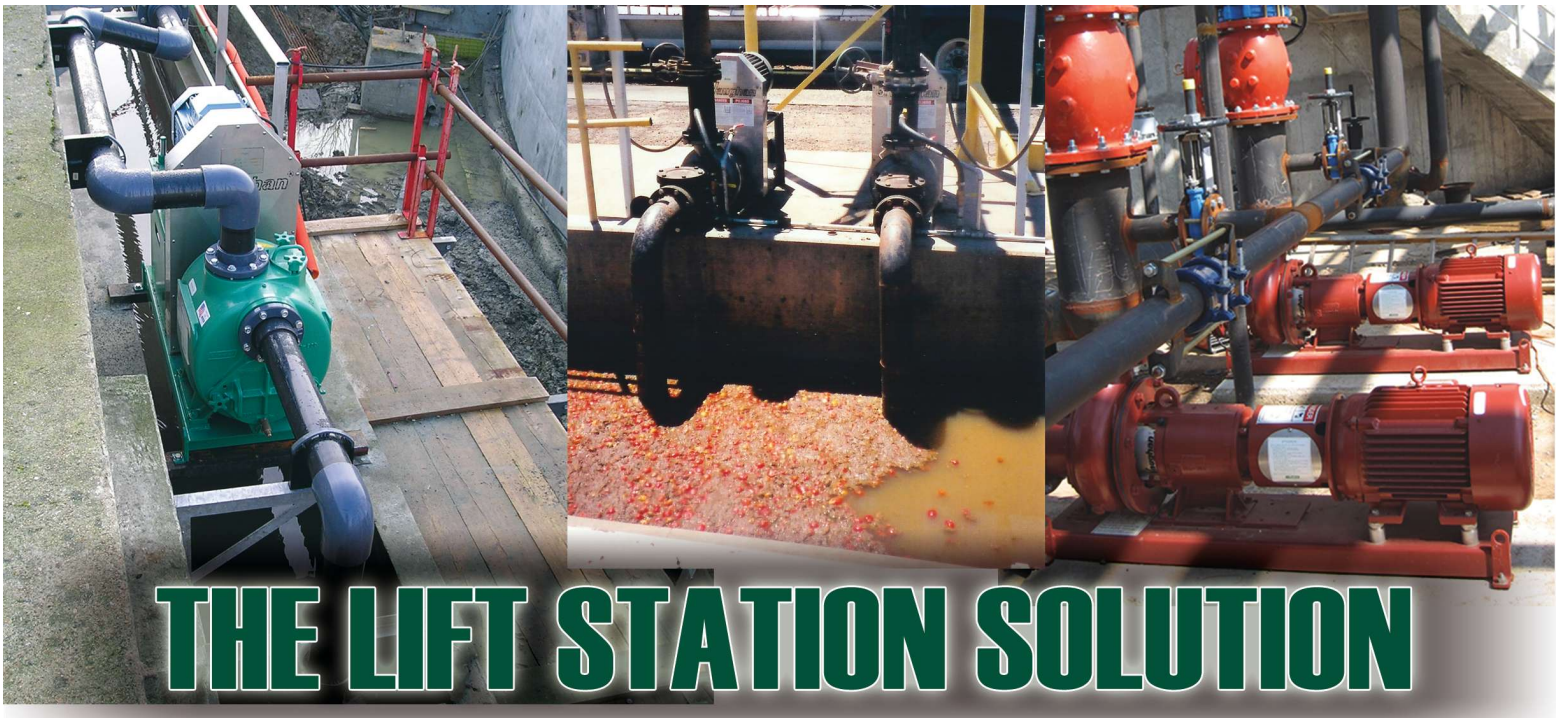
According to UOSA Executive Director Chuck Boepple, this energy performance contract created a nonthreatening way to ease in to energy projects with the utility's board of directors.

"Our board liked the fact that there was no cost associated with the preliminary audit," says Boepple. "The projects tended to sell themselves when the board was informed that the annual guaranteed savings would exceed the principal and interest on the loans that funded the projects."

Utilities that take this approach essentially transform reductions in O&M costs that result from a project into debt service for that project. Savings for carefully selected projects can equal or outweigh the new debt service, resulting in no increase in overall rates in the near term, more efficient operations, and, perhaps, additional money available for other priorities. Through performance contracting, utilities have an additional funding option to help make significant improvements to their facilities while alleviating capital budget pressures.

What could be better than that? ■

Peter Thomson (top) is a project director in the Gaithersburg, MD, office of Black & Veatch, and Fred Ellermeier (bottom) is a vice president in the company's Kansas City, MO, office. Together they lead Black & Veatch's ESPC services within Black & Veatch's global water business.



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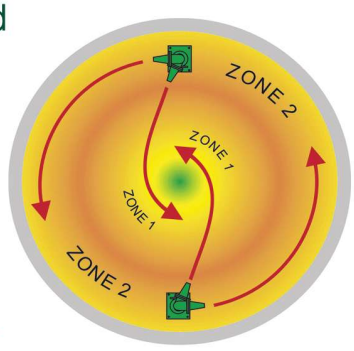

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Advanced Metering Infrastructure Provides Dynamic Growth Potential In North America

Tracking the AMI trend, and why it's important.

By Eric Meliton

With concerns regarding water scarcity and freshwater management in North America increasing, the added pressure on water utilities caused by rising labor and energy costs is beginning to take a toll. Water utilities are continuing to seek out ways to improve operational efficiencies, and smart water-metering technologies may provide a long-term solution. Advanced metering infrastructure (AMI) aids utilities in lowering maintenance and operational costs, despite short-term capital expenditure costs for implementation.

Some of the advantages of AMI technology include on-demand meter reading, remote connectivity, and increased meter reading and billing accuracy. These features are linked to advantages for water utilities in terms of cost savings and reduction of water losses.

Despite the long-term impact of the North American economic downturn on capital expenditure budgets for the municipal water utility marketplace, larger municipalities continue to explore the long-term benefits of AMI technology. Growth is expected to be moderate in North America, although many major initiatives to implement AMI technology may be delayed due to funding issues.

AMI aids utilities in lowering maintenance and operational costs, despite short-term capital expenditure costs for implementation.

Key Industry Trends

The U.S. Environmental Protection Agency (EPA) estimates that approximately 240,000 water main breaks occur in the United States each year. Water leaks of this nature result in major losses for the utilities due to disruption in services as well as increasing bill rates for customers for repair. Any level of water loss from burst pipes results in lost revenue for water utilities. Most water loss in the distribution network is linked to aging infrastructure, but can also be linked to hydraulic pressure issues and the number of pipeline connections. According to the American Society of Civil Engineers, nearly 2 trillion gallons of water (worth approximately $3 billion) are lost due to water leakages each year in the United States.

AMI technology, in tandem with other meters and data management systems, can assist with the following challenges:

- Efficient energy use related to distribution and treatment of water and wastewater
- Leakage detection and localization
- Grid pressure changes and adjustments to prevent service disruptions
- Event prediction and localization
- Maintaining customer satisfaction

Event prediction and localization have a larger market impact for older municipalities in North America, especially in larger cities that have an abundance of outdated water pipeline infrastructure. Millions of dollars are lost each year due to unforeseen pipe bursts and leakages. AMI technology can help with tracking and monitoring where leaks and pressure changes are likely, but can also assist in preventing future disruptions by determining which pipes, pumps, and valves need to be replaced.

AMI technology is perceived to have significant implementation costs. Although AMI technology is proven to reduce operational costs, the initial equipment and installation costs are high in this economic climate. Many municipalities are finding it difficult to justify the initial capital expenditure costs.

Market Potential

Efficient management of freshwater resources is becoming more important in the parts of the United States and Canada in which arid conditions persist. With freshwater withdrawal restrictions imposed on industrial end users and local residents, the need to reduce water loss by utilizing reliable water

management systems will continue to grow. AMI technology is a component of a larger smart water grid network that is slowly developing in North America. The smart water grid network is composed of automated meter reading (AMR) and AMI technology, combined with the information and communication technology (ICT) infrastructure required to manage automation and control data. Overall, the smart water grid market is growing at a moderate level as larger municipalities gauge the long-term need for this type of water management infrastructure.

According to ongoing Frost & Sullivan research, the total smart grid network market in North America was estimated to be approximately $2.32 billion (2011), which is composed of ICT infrastructure ($469.7 million), automation and control systems ($350.0 million), and smart water infrastructure ($1.50 billion). Based on this research methodology, AMI technology has overlapping applications in each market subsegment, but can be defined as part of the smart water infrastructure market subsegment, which also includes all types of meters, pumps, valves, pipes, data loggers, and transmitters.

Derived from this ongoing analysis of the AMI technology subsegment, key technologies sought after by the industry include: ultrasonic measurement meters, electromagnetic measurement meters, mechanical measurement meters, smart pressure reduction valves, and smart pumps. The ability to utilize a two-way communication with these AMI technologies ensures reliability, optimal performance, and preventative event management within the water and wastewater treatment and distribution network.

Conclusion

Even though the North American economic downturn has slowed the short-term investment enthusiasm surrounding AMI technology and the larger implementation of smart grid network technologies, the long-term need to address service and operational challenges persists. As water scarcity issues continue, and are combined with further growth of large urban centers across North America, the demand for AMI technology solutions will become more viable. With a solid North American competitive landscape consisting of major players such as Xylem, Sensus Metering Systems, Neptune Technology Group Inc., Badger Meter Inc., Itron, Elster Group, and Master Meter, competitive innovation and product development will continue to advance improvements to AMI technologies. ■

Eric Meliton is an environmental technologies industry analyst for Frost & Sullivan. His expertise includes industrial and municipal water/wastewater treatment technologies, regulatory affairs, and compliance. Meliton holds a Bachelor of Science in Chemistry and Environmental Science from the University of Western Ontario.

Water Regulations: A Fix For The Environment And The Economy

An overview of the most significant U.S. Environmental Protection Agency regulations affecting the water/wastewater industry in 2013.

By Dawn Kristof Champney

The American people have spoken. President Obama has been re-elected for a second term, yet he will face an even more divisive Congress than existed during his first four years in office. How that will impact his ability to carry out his environmental agenda remains in question. What is not in doubt is that his emboldened administration must make the case that environmental protection and economic prosperity are not mutually exclusive; environmental rules can actually drive economic growth and job creation. The Administration will be given ample chance to make that case with the plethora of pent-up water-related regulations waiting to be proposed or finalized in the next two years.

Ballast Water Discharge Standards

The U.S. Coast Guard issued a final rule on March 23, 2012, establishing for the first time a national standard for the treatment of ballast water discharges to protect U.S. waters from invasive species. Vessels subject to the regulations will be required to install and operate ballast water management systems to satisfy the treatment standards set forth by the rule, which mimics the standards established previously by the International Maritime Organization (IMO). The EPA, in turn, is scheduled to release a revised vessel general permit by March 15, 2013, to become effective December 19, 2013, establishing technology-based effluent limits for ballast water discharges similar to those issued by the Coast Guard and the IMO. The vessel general permit currently in place regulates ballast water through use of best management practices, including mandatory saltwater flushing in certain zones and ballast water exchanges at 50 nautical miles from shore. Progressing toward a treatment standard is a necessary step to thwart further introduction of invasive species, which have wreaked havoc with the nation's wastewater treatment plants as in the case of zebra mussels.

Total Coliform Rule

Final revisions to the existing total coliform rule were released by the EPA in December 2012, requiring public water systems vulnerable to microbial contamination in their distribution system to take corrective action and achieve compliance by April 1, 2016. The revised rule establishes a maximum contaminant level goal (MCLG) of zero for E. coli — a more specific indicator of fecal contamination and potential harmful pathogens than total coliform — and thereby eliminates the MCLG for total coliforms. It also provides an incentive for systems that improve their operations to qualify for reduced monitoring.

First published in 1989, the revised rule is estimated to affect approximately 154,000 public water systems — and 307 million individuals — at a cost of $14 million annually. The revisions will provide greater public health protection against waterborne pathogens in public drinking water distribution systems, according to the agency.

Cooling Water Intake Structures Rule

The EPA has extended by one year, until June 2013, release of a final cooling water intake structure rule requiring existing power plants and factories to install site-specific controls, or reduce their intake velocity, in order to reduce injury and death of fish and other aquatic life caused by cooling water intake structures. The EPA claims that the withdrawal of cooling water by facilities removes billions of aquatic organisms from the waters of the United States each year, impacting early life stages of fish and shellfish through impingement and entrainment. The proposed rule, published in April 2011, will affect an estimated 1,260 existing facilities that each withdraw at least 2 million gallons per day of cooling water, 590 of which are manufacturers and the other 670 are power plants.

Post-Construction Stormwater Rule

Due to the complex nature of this rulemaking, the EPA missed its fifth court-ordered deadline to propose a major "post-construction" stormwater rule setting numeric limits for pollution related to new development and redevelopment, such as subdivisions, roadways, shopping centers, etc. The rule is now scheduled to be proposed in June

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2013 and finalized in December 2014. The EPA is considering developing performance standards from newly developed and redeveloped sites to better address stormwater management, as well as evaluate additional provisions specific to the Chesapeake Bay watershed.

Coal-Fired Power Plants Effluent Guidelines

Also delayed was issuance of a rule revising the 26-year -old standards for wastewater discharges from coal-fired power plants, now scheduled to be proposed on April 19, 2013, and finalized a year later. It is expected that the existing standard governing these discharges will be tightened given the increased level of metals in power plant waste streams as a result of air pollution control measures having been employed. These 1,100 plants in the United States are responsible for a significant amount of toxic pollutant loadings discharged to surface waters, according to the EPA.

Environmental rules can actually drive economic growth and job creation.

Concentrated Animal Feeding Operations

The EPA announced that it will propose a court-ordered rule in April 2013, to be finalized one year later, expanding the universe of regulated concentrated animal feeding operations (CAFOs); a major source of phosphorus, nitrogen, and sediment discharges that adversely affect water quality. The EPA reports that the waste generated by large-scale conventional hog, chicken, and cattle operations has polluted more than 35,000 miles of river and has contaminated groundwater in 17 states.

Carcinogenic Volatile Organic Compounds

The EPA is scheduled to propose in mid-2013 a rule governing 16 carcinogenic volatile organic compounds as part of a new drinking water strategy to regulate contaminants by groups, instead of individually. Word on the street is that this approach is more complicated than originally thought, which could further delay its release. In order for contaminants to be regulated, they must be found in sufficient frequency to be of national concern and the regulations must present a meaningful opportunity for risk reduction, which may be a more difficult case to make when taking multiple contaminants into account.

Shale Gas Extraction/Coalbed Methane Extraction

Lastly, EPA has decided to combine the development of regulations governing wastewater discharges from shale gas extraction and coalbed methane extraction for proposal sometime in 2014. EPA reported that in 2008, 252 coalbed methane operators managed approximately 55,500 coalbed methane wells in the United States. Approximately 47 billion gallons of produced water are pumped from these wells annually, of which 45% is discharged directly into U.S. waters, with the balance discharged on land, re-injected into the ground, or reused. Produced water from shale gas operations ranges from 200 to 1,000 gallons per million cubic feet of gas produced, depending on the basin. Much of it is injected into wells or sent to treatment works. In the interim, the EPA is planning to soon release preliminary findings of a study it is conducting on the effects of hydraulic fracturing on drinking water, with the goal of issuing a final report in 2014.

These are among the most significant regulatory developments WWEMA is monitoring and commenting on. There are many others occupying our attention which deal with nutrients, water quality criteria, lead and copper, and other contaminants such as hexavalent chromium and perchlorate. Needless to say, it is going to be a busy couple of years ahead for the industry on the regulatory front. Likewise, for the technology and service providers within WWEMA, who are tasked with providing cost-effective solutions to meet these and other challenges confronting the water industry.

Protecting the water environment is not only essential for life, it is the underpinning of all social and economic activity. There is not a single job or business that does not rely to some degree on water, its provision and its treatment. We must remain vigilant to ensure that sound science governs the way we regulate and protect this life-giving resource, while at the same time, promote the fact that environmental regulations are responsible for creating a viable industry that generates nearly $130 billion in annual revenue in the U.S. and employs hundreds of thousands of skilled workers, further supporting the case that investing in and protecting our nation's water infrastructure makes good business sense. ■

Dawn Kristof Champney is president of the Water and Wastewater Equipment Manufacturers Association (WWEMA), a Washington, D.C.-based national, non-profit trade organization that has represented the interests of manufacturers serving the water supply and wastewater treatment industry since 1908.

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Why import water when you can recycle it (to unprecedented levels)?

By R. Bruce Chalmers

Established in 1959, the Water Replenishment District of Southern California (WRD) manages the groundwater resources of the Central and West Coast Groundwater Basins of California. Management includes maintaining adequate groundwater supplies, preventing seawater intrusion into the underground aquifers, and protecting groundwater quality against contamination. WRD provides water to spreading facilities and three seawater intrusion barriers, including the Alamitos seawater barrier. WRD imports potable water from the Metropolitan Water District (MWD), and produces advanced treated recycled water from the Leo J. Vander Lans water treatment facility (LVLWTF).

As part of their Water Independence Now (WIN) program, WRD is working to eliminate the dependence on imported water by developing local resources to create a sustainable groundwater supply. It plans to accomplish this by implementing a series of projects that use stormwater and recycled water to restore and protect the groundwater resources of the Central and West Coast Groundwater Basins.

When finished, the facility will have the highest recovery rate of any MF/RO/UV AOP indirect potable reuse plant in the country.

To replace the use of imported water in the Alamitos barrier, WRD is expanding the LVLWTF capacity from 3 million gallons per day (mgd) to 8 mgd. Tertiary treated (Title 22) recycled water supplied from the adjacent Los Angeles County Sanitation District's (LACSD's) Long Beach water reclamation plant (LBWRP) is the influent to the LVLWTF. WRD is also considering use of tertiary effluent from LACSD's Los Coyotes water reclamation plant (LCWRP) located 6 miles north.

Similar to the existing plant, the expansion will use the same microfiltration (MF), reverse osmosis (RO), and ultraviolet (UV) advanced oxidation systems, but the overall plant recovery rate will be increased from about 80% to 92%. The plant must be expanded without increasing the waste discharge to the sewer, which conveys the RO brine and other waste streams to a downstream wastewater treatment plant. The current limit of 760,000 gallons per day (gpd) cannot be increased because of a downstream hydraulic constraint. The additional 5 mgd of treatment capacity will be built with an MF backwash treatment system to recycle MF backwash water and a high recovery RO system to reduce RO concentrate flows.

The MF backwash treatment system will use a dissolved air flotation (DAF) system and a backwash treatment MF system to increase the overall MF recovery to over 98%. A third-stage, high-recovery RO train will be added to the RO system to increase the RO recovery to more than 92%. Implementing these two new processes will keep the waste flows from the 8-mgd plant under 760,000 gpd. When finished, the LVLWTF will have the highest recovery rate of any MF/RO/UV advanced oxidation process (AOP) indirect potable reuse plant in the country.

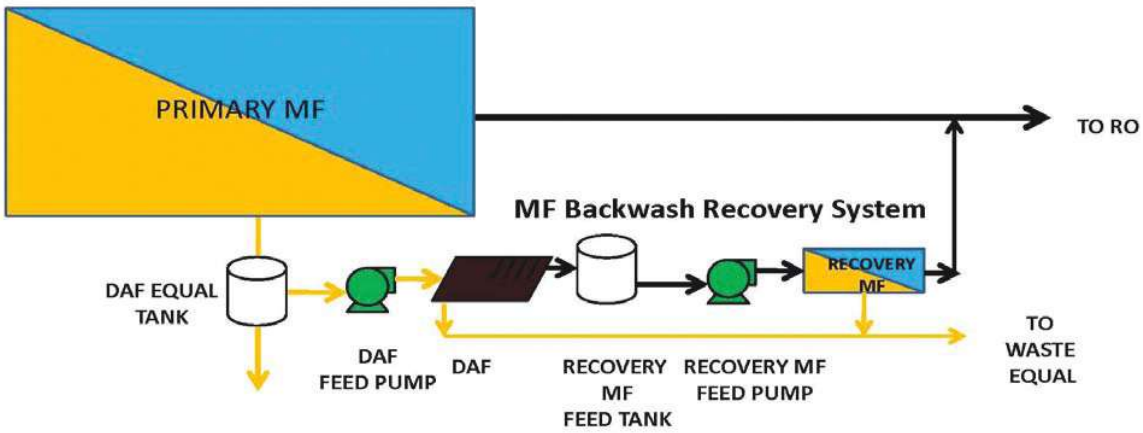
Site And Treatment Processes

Microfiltration System — The existing Pall MF system will be expanded to provide approximately 8.14 mgd of MF filtrate (MFF). Six new Pall MF Quad racks with 100 modules per rack (600 modules total) will be installed. The MF system is sized for an instantaneous flux rate of 31 gallons/foot/day (gfd). Half of the current MF system (100 modules) will be moved to one of the new MF racks, while the other half will be modified to treat the MF backwash water. The Pall system will operate at a recovery rate of 94%. The MFF will be discharged into an MF break tank to equalize the flows between the MF and RO systems.

MF Backwash Treatment System — The MF waste backwash wastewater (BWW) will be treated by DAF and MF and used as RO feed water. Prior to selecting DAF/BWW MF, plate settlers were investigated with the filtrate returned to the LVLWTF influent. The plate settler process arrangement is similar to other MF backwash treatment systems in the United States and Australia. Results from jar tests to determine the coagulant dose were inconclusive, as some of the tests showed adequate settling while other tests showed little or no settling because the floc was light and did not settle readily.

Therefore, DAF clarifiers were evaluated as an alternative treatment process to the plate settlers. The results of the DAF

Figure 1. MF and MF backwash treatment systems



jar tests performed on water samples from the membrane backwash water showed the increased removal potential for the DAF as the coagulated solids floated readily. Turbidities as low as 1.52 nephelometric turbidity units (NTU) were achieved with coagulant dosages ranging from 10 mg/L to 30 mg/L for both alum and ferric chloride. The DAFs are about the same size and cost as the plate settlers so that there was minimal impact to the design.

The proposed MF BWW treatment flow diagram is in Figure 1. Four of the existing eight 25-module racks will be used for the MF BWW treatment system. Essentially, only the header piping must be modified, as no significant changes are required to the racks themselves. The MF backwash treatment system will provide 0.51 mgd of MFF to the RO. The BWW MF system will have an instantaneous flux of 24 gfd (see Figure 1 above).

Reverse Osmosis System — The current 3-mgd, two-stage RO system will be expanded to produce 3.7 mgd of RO permeate (ROP) by modifying the piping and increasing the flux rate from about 10 gfd to 12.2 gfd. A nearly identical two-stage, 3.7-mgd primary RO train will also be constructed as part of the expansion. The two-stage primary RO system trains will continue to have a recovery rate of 85%. To reduce the brine flow and increase the overall RO System recovery, a third-stage RO system will be added to treat RO concentrate (ROC) from the two second-stage trains.

The third-stage RO system was successfully pilot-tested to confirm the feasibility and design parameters of the treatment and cleaning programs. The study allowed for the evaluation of the required 52% recovery rate, as well as the procedures for optimizing the RO cleaning regimens for the third-stage membranes.

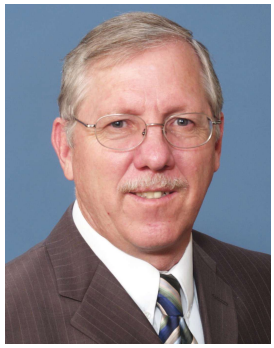
UV-A System — The expansion will also add new Trojan UV equipment. Hydrogen peroxide will be added to enable advanced oxidation treatment. Because there is no waste from the UV-A, the UV-A system is not critical for the design of the plant recovery rate.

Miscellaneous Wastes — Chemical waste discharges from the MF, the BWW MF treatment system, and the RO clean-in-place (CIP) flows will be neutralized and discharged to an on-site waste equalization system and not recycled. The RO concentrate will also be conveyed to the plant waste equalization tank and not recycled.

Permitting — The LVLWTF plant expansion will be permitted by the Regional Water Quality Control Board (RWQCB) as a modification to the existing permit. The LVLWTF will be the first indirect potable reuse plant permitted under the new November 2011 draft of the California Department of Public Health (CDPH) recharge regulations.

Project Costs

The LVLWTF bids were submitted on September 12, 2012. Flatiron West was the approved low bidder with a price of $31,369,470. The MF and UV systems were preselected by WRD as part of the design to match the vendor equipment constructed as part of the original design. The cost of the MF system was $4,733,023. The UV system was procured in a similar manner as the MF system with the cost of $2,566,447. A Notice to Proceed was given on November 13, 2012 with an approximate 18-month construction period. ■

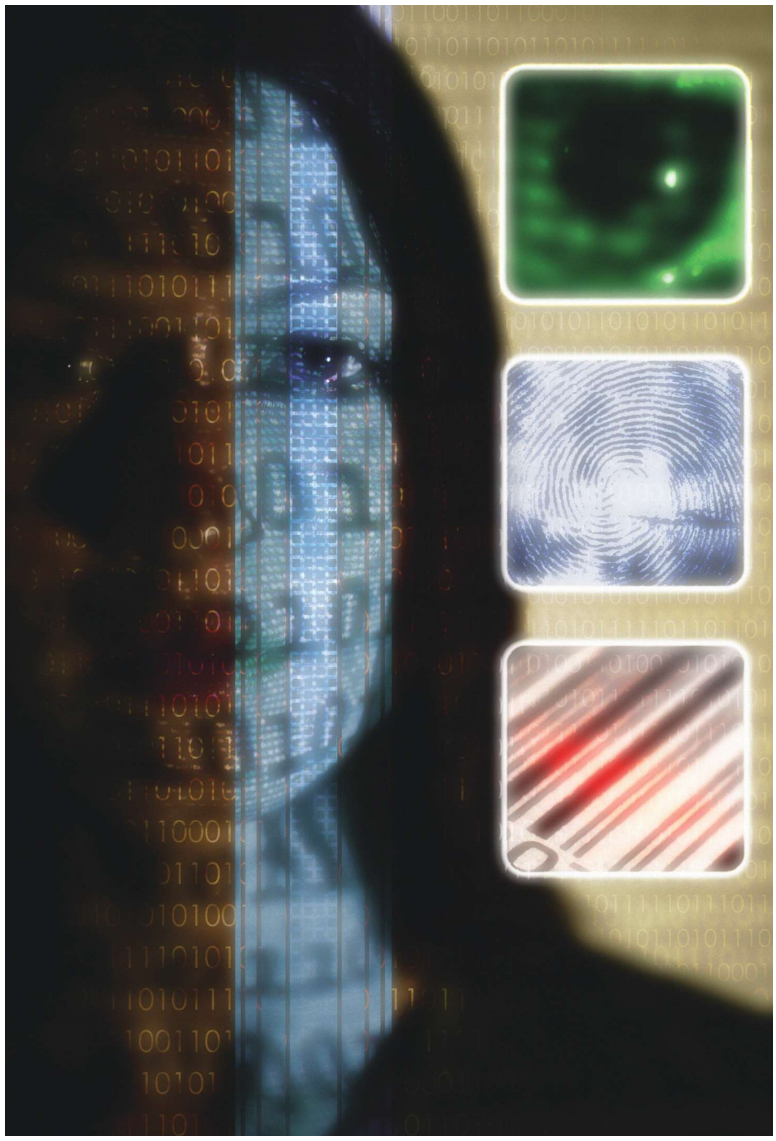


R. Bruce Chalmers has 32 years of design and managerial experience in the fields of water and wastewater engineering, including planning, design, and construction management. He has a BS from UCLA and an MS from California State University Long Beach. He is a vice president with CDM Smith in the Irvine, CA, office. He is a member of the WateReuse and AWWA Desal committees and the secretary for the AWWA Reuse Committee.

Who Will Stop The Hackers?

With cyber threats against critical water infrastructure on the rise, the U.S. government, utilities, and private security firms seek solutions before it's too late.

By Kevin Westerling



The nation's cybersecurity issue has been festering for an uncomfortably long time. It's a crisis waiting to happen, and each day the threat is ignored is a gamble. Eventually luck runs out, however, and the folks in Washington have deemed that the stakes are simply too high to leave to chance, especially when the odds of avoiding a catastrophe get ever-slimmer.

In the last year alone, the number of attacks against critical infrastructure reported to the Department of Homeland Security (DHS) increased by 383%, according to U.S. Senator Tom Carper (D-Del.), Chairman of the Homeland Security and Governmental Affairs Committee. "We are constantly learning of new cyberattacks on our critical infrastructure, government systems, and businesses," he told me. "And it appears there is no end in sight."

Specific to water and energy utilities, Sanaz Browarny, chief of intelligence and analysis for the control systems security program at the DHS, stated at the 2012 GovSec conference that such attacks occur "on a daily basis."

The concern is heightened by the origin of the attacks. A recent report, released in January 2013 by Akamai Technologies, revealed that China is not only the biggest culprit, but also the fastest-growing. In the third quarter of 2012, China accounted for 33% of cyberattacks, more than double the previous quarter. That's far more than even the second and third countries combined — the United States and Russia, respectively, at 18%.

If identifying the problem is the first step to solving it, then some credit can be given to Democrats and Republicans for coalescing on the fact that cyberattacks pose an imminent threat to critical infrastructure and, by extension, the public. Cyber infrastructure is defined as "critical" when an attack could reasonably result in the interruption of life-sustaining services, catastrophic economic damage, or severe degradation of national security.

High stakes indeed.

It's no wonder, then, that the country's two political parties actually agreed on something — to take action on cybersecurity. But then the political "process" took over.

Politics And Cybersecurity

The Cybersecurity Act of 2012, introduced by a bipartisan group of sponsors (Sen. Carper included), was roundly criticized by Republicans for including federal mandates for security measures to be put in place — later watered-down to voluntary best practices. The opposition argued that even voluntary standards could provide a "back door" to regulation, and thus construed it as government overreach and anti-business (since most security systems are run by private companies). In response, they presented the SECURE IT Act (Strengthening and Enhancing Cybersecurity by Using Research, Education, Information, and Technology), but Democrats countered that it was too lax because it relied solely on information-sharing among the government and private industry, and that the latter is not typically driven by public safety. SECURE IT, the Democrats argued, lacked regulatory teeth, as it featured no regulatory requirements, or even best practices, that would coerce vendors to address vulnerabilities in software systems within information security or control systems.

As 2012 came to a close, there was no meeting of the minds, no compromise, and no cybersecurity legislation. But with the threat of a crippling cyberattack still hanging over our collective heads, the issue doesn't go away. When the second version of the Cybersecurity Act of 2012 failed, President Obama began

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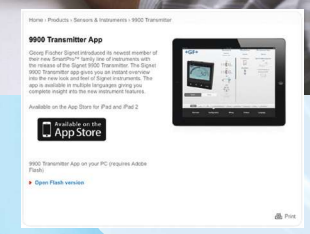

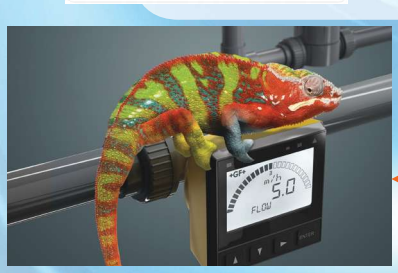

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constructing an executive order (EO) that would maintain voluntary best practices, jointly determined by a collection of private businesses and the DHS, but would not — because it legally could not — include the compliance incentives that the bill would have provided.

Even if the EO is issued — at the time of writing it was under consideration — the bottom line remains the same: in the absence of true cybersecurity legislation, much of the onus is on utilities and security providers to protect water infrastructure and consumers.

For its part, the federal government is taking steps to facilitate this task. A recent report by enterprise software and information solutions provider Deltek, forecasts that federal spending on vendor-supplied information security tools and services will grow from just under $10 billion in 2012 to $14 billion in 2017, or 7.6% annually over the next five years.

Furthermore, every government proposal put forth recommends that a framework be set up to enable information sharing, which politicians from both parties and security experts agree is the key to combating cyberattacks and mitigating their impact. Such a framework would allow for unprecedented knowledge transfer, whereby the government can issue security clearances for private companies to access classified information. However, it will also be incumbent upon the government to provide assurances that privacy and civil liberties are protected — one of the thornier issues that arose during the legislative process.

Security is not part of water expertise, and water devices were certainly not built with security in mind.

Pending the rollout of this information-sharing framework, I asked Senator Carper what immediate steps water utilities can take to better protect themselves from cyber threats. His response was to practice good "cyber hygiene," which would entail, first and foremost, a thorough risk assessment of your systems and practices. With both the threat and the information technology landscape changing so rapidly, there are multiple levels of consideration.

Taking Action: Steps To Assessing And Resolving Risk

To paraphrase former Secretary of Defense Donald Rumsfeld, there are known knowns, known unknowns, and unknown unknowns. While this quote is infamous for eliciting a nationwide "huh?", it actually represents valid and logical risk-assessment methodology — long-used by the military and later adopted by NASA for its space missions.

Here's how Rumsfeldian risk analysis would apply to the water sector, with action items to address each type of risk.

Known Knowns — Things That We Know We Know

This category would include known viruses, such as Stuxnet, as well as the vulnerabilities that have been exposed by such viruses. Discovered in 2010, the Stuxnet worm — called "the most menacing malware in history" and "the world's first real cyberweapon" by *Wired* magazine[1] — targeted Siemens industrial software and equipment, doing specific damage to nuclear facilities in Iran (as was intended, it is widely surmised). Stuxnet is notable in that it was the first known malware to spy on and subvert industrial systems, using Microsoft Windows as a pathway to gain access to the supervisory control and data acquisition (SCADA) system.

Patches for Stuxnet were developed, but a larger issue persists, says Nate Kube, CTO at Wurldtech Security Technologies. "This kind of malware is a threat to all networked systems, not simply because it attacked a control system, but because it combined multiple, state-of-the-art attack techniques to deliver its payload and produce the intended consequences," Kube warned. "The delivery mechanism is highly modularized, just like a professional software application. It can be easily retooled for a different target using new exploits."

While Stuxnet was initially delivered through removable portal media such as USB flash drives, there are multiple points of exposure, or vulnerabilities, when it comes to cyber intrusion. The most egregious is to have your control system directly connected to the Internet, and according to Kube, this is not uncommon in the water industry. For example, in the wake of Stuxnet a 22-year-old hacker gained full access to a South Houston water treatment plant — all because the information was readily available on the Internet, found through a search engine called Shodan that specifically mines IP addresses. In addition to exposure through portal media and the Web, cyber threats can be introduced through support systems connecting to the local network, already-compromised systems connecting over a virtual private network (VPN), or by a trusted insider.

How to prepare: Install patches or defenses such as intrusion detection/prevention systems for all known threats, and be wary of connecting systems directly to the Internet. If your equipment is online, the best way to defend against discovery tools like Shodan is to ensure that no information is present on Web pages that aren't behind a login screen or in banners for terminal services such as Telnet or SSH (Secure Shell).

Known Unknowns — Things That We Know We Don't Know

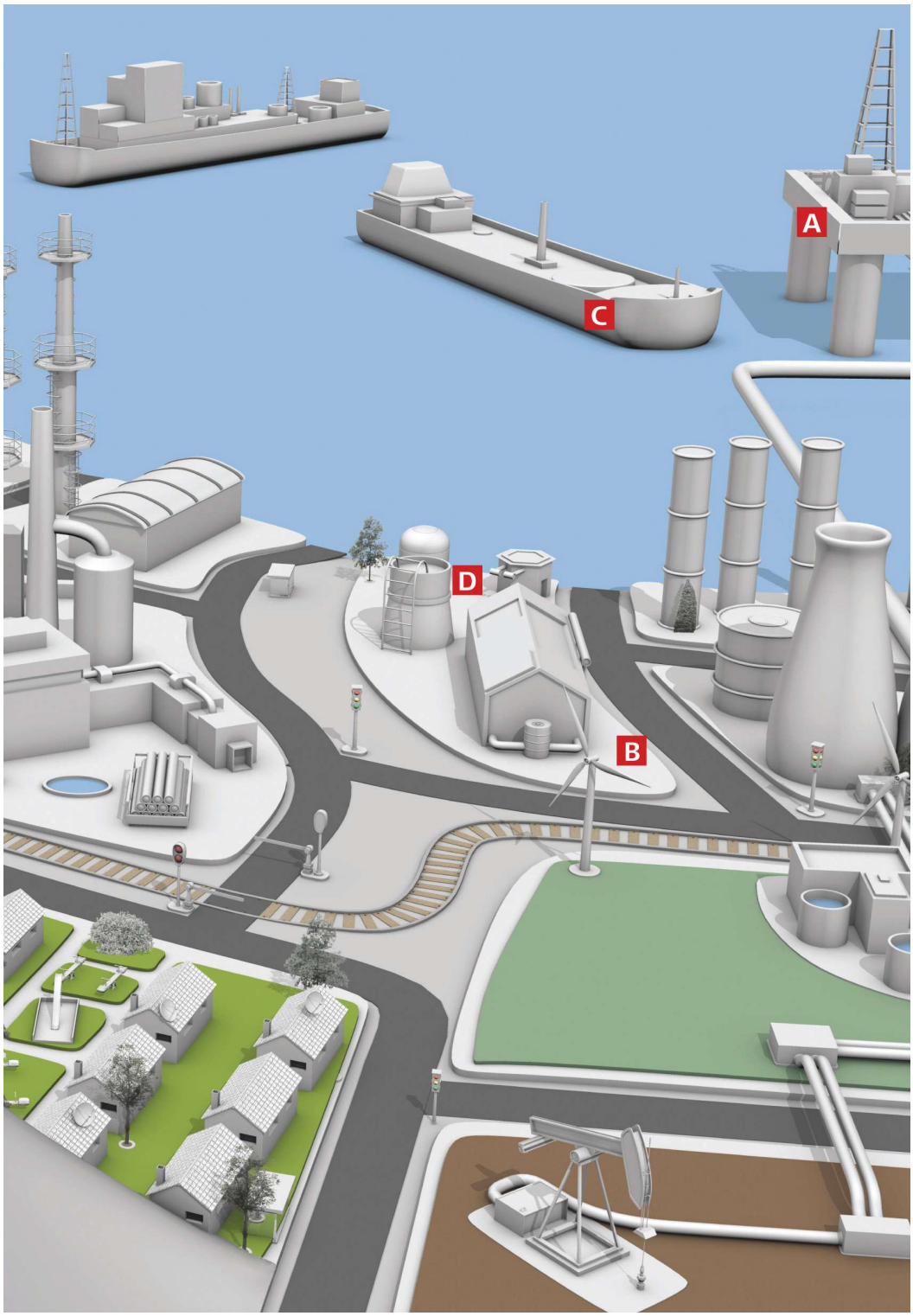
We know that there are new viruses and malware being developed and that there are malicious entities targeting utilities at an increasing rate, but the nature of the attack — the who, how, and where — remains unknown.

Malaysia
Off-Shore Plant,
Oil-rig, Injection water.

Australia
Membrane Protection,
Methane Coal Mine

Singapore
FPSO filtration-Off-
Shore,Injection water.

Spain
SWRO Desalination
Plant, UF Pre-filtration



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In the last year alone, the number of attacks against critical infrastructure reported to the Department of Homeland Security increased by 383%.

How to prepare: Even after securing against known threats and vulnerabilities, utilities cannot rest on their laurels. Ongoing investment in security is needed to better prepare for not just today's threats, but what may come tomorrow. Point products are not enough, as attackers are developing methods to evade conventional defenses. What's necessary is a comprehensive security management strategy, which may also require outsourcing to experts. Security is not part of water expertise, and water devices were certainly not built with security in mind. Even for the experts, the fix is neither quick nor easy.

Chris Blask, founder and CEO of ICS Cybersecurity, helps frame the task at hand, "There are more than 18,000 water systems in the United States. If we as a nation decided today that cybersecurity is one of the most important things we can do, 1, 2, or 3 years is not long enough to get it done. Considering the risk context that water systems face — what it was 1 year ago, 5 years ago, and 10 years ago, and what it will be in 1 year, 5 years, and 10 years — it seems very clear that right now is the time to start addressing this. This is a process that not only will take a long time, but really has no end."

Unknown Unknowns — Things We Don't Know We Don't Know

Perhaps scariest of all are cyberattacks devised and delivered in a way that has yet to be imagined. By definition, it's impossible to ready specific safeguards or remedies for the unknown unknowns, but you can nonetheless prepare emergency procedures.

How to prepare: There are four acknowledged phases of emergency management. The first is mitigation — incorporating measures to reduce or eliminate future risk — which was largely addressed in the two previous risk segments. From 2009 to 2011, the U.S. Environmental Protection Agency (EPA) conducted collaborative, state-level water sector emergency response exercises to address the remaining three phases: preparedness, response, and recovery. What follows are the "lessons learned" that were included in the 2012 report.

- Plan and coordinate with response partners before an incident. Coordination before an incident occurs and during the incident response ensures that all water sector response partners in a state will have the situational awareness essential for appropriate response and resource management.
- Be prepared to conduct damage assessments. Utilities are encouraged to complete pre-incident infrastructure assessments to expedite recovery and reimbursement for repair or replacement of damaged infrastructure.
- Be prepared to request resources. Water utilities should become familiar with local and state procedures to properly request the necessary resources for returning to operation after a disaster-related service interruption.
- Plan for provision of alternative water supplies. Develop a plan to provide an alternate drinking water supply (e.g., bottled water, bulk water, wells, and temporary treatment and distribution systems) to customers in the event of prolonged service interruptions.
- Incorporate lessons learned into response plans. Utilities and their response partners should regularly review and update their emergency response plans (ERPs) and other related plans to include lessons learned from trainings, exercises, and actual responses.

Conclusion

The climate on cyber threats as they relate to critical infrastructure — the proliferation of incidents, the attention of Congress and the president, warnings from security experts — seems to indicate that we are on borrowed time. A cyberattack will happen, we are told. The federal government may offer a measure of help to combat it, but may also obstruct itself to the point of inconsequence. Mostly, utilities and security providers must help themselves — and each other — by getting up to speed on security protocol and by sharing vital information. Technology, like the people who wield it, can be both good and bad. As we anticipate the inevitable, the best defense is to stockpile the good to overcome the bad. ■

1. Kim Zetter,"How Digital Detectives Deciphered Stuxnet, the Most Menacing Malware in History," *Wired*, July 11, 2011.
2. U.S. Environmental Protection Agency, Collaborative State-Level Water Sector Emergency Response Exercises 2009-2011: LESSONS LEARNED (Washington, D.C.: EPA 817-R-12-005, May 2012).

Kevin Westerling is the editor of Water Online, the Internet's premier source for water and wastewater solutions, in addition to the numerous forms of Water Online The Magazine. As such, he drives the editorial content for the website, the associated newsletters, and all magazine/e-zine publications.
Kevin joined VertMarkets in 2006 and became Water Online's editor in 2008. His education includes a bachelor's degree in English Literature, a minor in Journalism, certification as a Web Content Developer, and, most significantly, real-world training on the beat for the ever-evolving water industry. Kevin can be reached in our Horsham, PA, office at 215.675.1800 x120 or kwesterling@vermarkets.com.

ENVIRONMENTAL SERVICES
by Dan Theobald

WASTEWATER DAN

Dan Theobald

Dan is the owner of **Environmental Services** and is a professional **Wastewater and Safety** consultant and trainer. Dan, known in the industry as **"Wastewater Dan"**, has twenty years of hands-on experience operating many variants of wastewater treatment processing units, and is a trainer in **Wastewater & Industrial Health & Safety** topics. He serves as an active consultant to a variety of industries, achieving and maintaining **improved wastewater treatment at less cost**. Dan is a Lifetime Member of the "Who's Who Registry of Professionals."

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Enabling Wise Infrastructure Investments

A new program allows utilities to learn from each other in the battle against failing infrastructure.

By Carrie W. Capuco, Walter Graf, Ravi George, and Carita Parks

Condition assessment and renewal engineering are critical to infrastructure asset management, now more than ever, in the face of aging and deteriorating wastewater and drinking water infrastructure. As utilities encounter failing infrastructure, they tend to look for which condition assessment and renewal engineering technologies they should employ.

In response to this need, Water Environment Research Foundation (WERF) researcher Dr. Sunil Sinha, Associate Professor of Civil and Environmental Engineering at Virginia Tech, developed the WATERiD knowledge base (www.waterid.org). It is envisioned that WATERiD will help utilities reduce expenses by allowing them to compare methods and learn from the experience of other utilities on the effectiveness and performance of various techniques and technologies. "Water infrastructure is invisible and typically considered a local issue. On several occasions, renewal planning for water infrastructure has been on the cusp of becoming a national political platform issue, only to be knocked out of the spotlight by other suddenly pressing issues. One would think that infrastructure renewal for sustainable access to clean water would actually be leveraged more fully as a prominent national issue for generating political consensus," remarks Sinha. "Our nation's infrastructure is the historical backbone of our economic success. Wise infrastructure investments have paid for themselves many times over in the economic productivity of our nation."

With WATERiD, utilities can assess whether a practice or technology is right for their situation.

Learning From Peers

In WATERiD, users can find all relevant information that helps with decision-making on condition assessment, renewal engineering, underground infrastructure-locating technologies, model tools, and best appropriate practices. It provides a medium for the dissemination of cost, performance, capability, and limitation information. With WATERiD, utilities can assess whether a practice or technology is right for their situation, because the hierarchy of information is organized so utilities can contact associates and colleagues through utility HUB pages, in private forums, and through a peer-to-peer review process. It includes technology profiles and management practice summaries, and supplements information about individual technologies' cost and performance, with case studies. The knowledge base contains lists of vendors, consultants, and contractors for a particular technology by regions: Atlantic, Midwest, Southern, and Western.

The information and experiences shared through this research are managed by Virginia Tech graduate students who continually update the knowledge base with case studies and performance assessments. Unlike a static state-of-the-practice report, WATERiD will always stay current. Dr. Sinha and his graduate students gather information to maintain the knowledge base. Over the last year, they have traveled to more than 100 utilities around the country, compiling more than 300 case studies and technology data sheets on underground pipes.

"Constantly updating this knowledge base with state-of-the-art best practices and technologies and engaging facilities in submitting experiences, case studies, and finding out what they are applying at their facilities is very important," explains Sinha. "Assessing that gap between our current practices and current technologies is an important first step in beginning to implement a condition assessment and renewable engineering program."

Some may find these case studies to be one of the most appealing aspects of WATERiD. Reviewers have already

commented about their utility being able to see how a technology performs under unique scenarios comparable to their own. Much like the trending 'wiki' sites, utilities can submit their own case studies. Once they are submitted, editing rights belong to the Virginia Tech graduate student site administrators. Sharing this information in consistent formats is key, not only to the industry, but to researchers and developers wishing to see how products and technologies perform in the field, and where improvements can be made.

Walter Graf (left) receives the 2012 WATERiD Leadership Award from Virginia Tech's Sunil Sinha.

A 'First' In Research

The project goes even further. Using an extract-transfer-load process, WATERiD can pull information from municipal and utility websites, displaying all technologies, methods, and practices in one place. This capability was tested by the Town of Blacksburg Public Works Department (VA), and is the first time all of this information has been in one place. It links to relevant case studies concerning Blacksburg's implementations, as well as technology data sheets and bid information. Eventually, all data about a utilities' water infrastructure and asset management will be in one location to obtain information, and as they update their sites, WATERiD updates as well.

The WATERiD project is a resource that will never and should never be "complete," as it is a dynamic knowledge base that requires the constant participation of the industry to evolve. The project team is working hard to engage the industry on the website, and Sinha, through his efforts with WATERiD, is also working hard to engage the academic community.

"While the civil engineering expertise has been absolutely required to understand and capture the state of the practice for condition assessment and renewal engineering through utility experience, the academic measures required to successfully data-mine the experience of utilities and to academically document findings, required a research approach that is exceptionally uncommon for the civil engineering field," said Sinha. "We hope the academic foundation we have laid with WATERiD will permit the industry to more fully explore the practices associated with condition assessment and renewal engineering of drinking water and wastewater pipelines, as well as providing a robust knowledge base for sharing that knowledge for application."

Award-Winning Work

The WATERiD project is funded under the Innovation and Research for Water Infrastructure for the 21st Century cooperative agreement between the U.S. Environmental Protection Agency and WERF. Virginia Tech recently recognized the contributions of the WERF Program Director, Walter Graf, to this project. Virginia Tech awarded Graf a WATERiD DUG (Database User Group) Award, which recognizes the outstanding individuals who championed and supported the research, development, implementation, and population of WATERiD. Graf was honored alongside other WATERiD Award winners at the 12th Annual Water Utility Infrastructure Management (UIM) Asset Management Conference Awards Dinner on November 28, 2012 in Arlington, VA. ■

This article was prepared by a team of WERF authors. Technical content was provided by WERF Program Director, Walter Graf; copy was drafted by editorial staff Ravi George and Carita Parks. Editing was provided by WERF Director of Communications, Carrie Capuco.

Thinking About Creating A Regional Utility? Here Are Three Things To Consider

Decentralization may be the wave of the future, but only if the shoe fits.

By Jason Mumm and Marilynn Robinson

In September 2010, the U.S. Census Bureau confirmed something many Americans already sensed — income levels throughout the U.S. had and were continuing to fall. Around the same time, the U.S. Conference of Mayors released a report projecting spending for local water and wastewater utilities would triple or quadruple to as much as $4.8 trillion over the next 20 years in order to address needed infrastructure improvements.

These economic indicators show that the affordability of services is and will likely remain one of the most challenging issues for water and wastewater utility managers and local elected officials. Traditionally, increasing rates served as the approach for addressing funding gaps; however, with strains on income levels in the U.S., utilities are seeking economies of scale to create meaningful and sustainable solutions that reduce the burdens on rates.

Utility regionalization is a potential solution. While often politically contentious, the consolidation of services under a regional structure can produce economic benefits, leading to lower average costs per unit and lower rates for service. However, each utility must consider various factors, including financial impacts, service level impacts, and governance changes, before embarking on a regionalization of services.

With utility regionalization, results vary.

Studying The Economic And Financial Impacts

The first and most obvious question to ask when reviewing potential regional opportunities is, "Is this economically and financially viable?" This is a question not only asked in regards to the utilities' finances, but also for ratepayers.

Starting at the baseline evaluation, or current financial state, utilities need to prepare a value analysis for various available options, which can range from regionalizing one or more utilities to keeping the existing structure. These analyses include financial needs for capital facilities, estimating asset lifecycle costs, and operating expenses. Through various methods, an average total cost per customer for each scenario is created and compared to the others to determine the option that allows everyone to win.

For example, a utility located in Colorado needed to perform a cost-benefit analysis to test the feasibility of consolidating the existing district with three different neighboring agencies. For this client, MWH measured the total cost of service under various regionalization scenarios, including costs paid from typical user fees and property taxes. Factoring all costs together, MWH was able to compare each alternative on the basis of the average cost per unit of service provided.

Ultimately, the cost-benefit analysis showed that consolidation provided economic benefits in only one of the proposed scenarios. Another scenario showed that while the utility would enjoy cost savings, the agency taking over the utility's operations would see rates for their own residents increase rather than decrease. The utility opted to pursue the option that provided the best financial and economic results for the utility and the ratepayers.

Understanding The Service Level Impacts

At the center of any regionalization is the question of service delivery. Parties entering into a regionalization need to understand the required service levels. Key questions that require agreement are, "What's being provided before the regionalization?" and "What will be provided after the regionalization?" In many situations, it is likely that one of the parties is providing service at a different level than the others. Understanding those differences going into the regionaliza-

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tion is critical in framing the economic costs and benefits. What is the plan for equalizing the service levels? How much will it cost? Is there a willingness to decrease some levels of service in order to equalize them? These are all important questions that have to be addressed. What you can't have in a regionalization is a supposed cost savings that is actually the result of decreased service: that's not a real economic benefit; that's just repackaging. Make sure economic costs and benefits are real by reaching an early understanding of the levels of service and the costs involved in obtaining them.

Recognizing Governance Changes

Economic and financial viability and service level issues for the utilities and community are the first gateways to gaining buy-in for a regionalized approach. In the process of conducting the economic feasibility analysis, it is important to gain a working understanding of the future governance of the utility. Utilities must identify governance issues that are "deal killers." For example, if the merger of the utilities is forbidden by law, then there is nothing further to discuss. In most cases, governance is an issue that can wait for resolution until after the parties can agree that the merger is mutually beneficial for service reasons and economic benefits. Too often, governance is placed first and foremost in regionalization studies. There is no doubt that governance is critical, but agreeing on governance issues requires agreement on other issues first. If the proposed regionalization doesn't make sense for service or economic issues, then it will not make sense from a governance perspective.

The value of governance is linked to control, and control has intrinsic value in many communities. As an example, an MWH client faced possible fines by the state of Colorado after years of neglect of its existing wastewater treatment facility. The plant was out of compliance with federal permits, and while the utility's new management found operating strategies to put the plant back into compliance, there was a need to replace the plant at a cost of $15 million. In addition, the utility needed to replace its water supply source from non-renewable groundwater supplies to surface water with a capital cost near $50 million for water rights and $20 million for a new water treatment plant. The utility needed to examine the feasibility of consolidating its water and wastewater operations with its neighboring utilities to address these increasing capital costs.

In this example, the economic and financial benefits quickly became obvious; however, the governance issues made the analysis more complex. The utility's operations included not only service to its own residents, but also service to three other sub-districts through intergovernmental agreements. Any changes in service provider would have to satisfy these agreements. Ultimately, despite the economic feasibility of the consolidation for the utility and most sub-districts, the ballot issue was voted down by the community citing disagreement over issues of operations and governance, and the desire for local control over the utilities despite potential economic savings.

Utilities are seeking economies of scale to create meaningful and sustainable solutions that reduce the burdens on rates.

Conclusion

Successful regionalization of utility service is an often touted but not often implemented strategy to increase cost efficiency. It is important to recognize that regionalization in and of itself is neither efficient nor inefficient, it is simply an approach. Ideally, a regionalization will provide for greater use of capital assets and reductions in average costs per unit of service. Economic analyses can help identify the potential wins and losses, and that analysis needs to start with some basic working assumptions on service levels and governance. Reaching consensus on regionalization efforts is elusive, but by going to the numbers sooner rather than later, utilities can determine whether regionalizing is a winning strategy and start to build buy-in while continuing to work through more detailed understanding of service levels and governance models. ■

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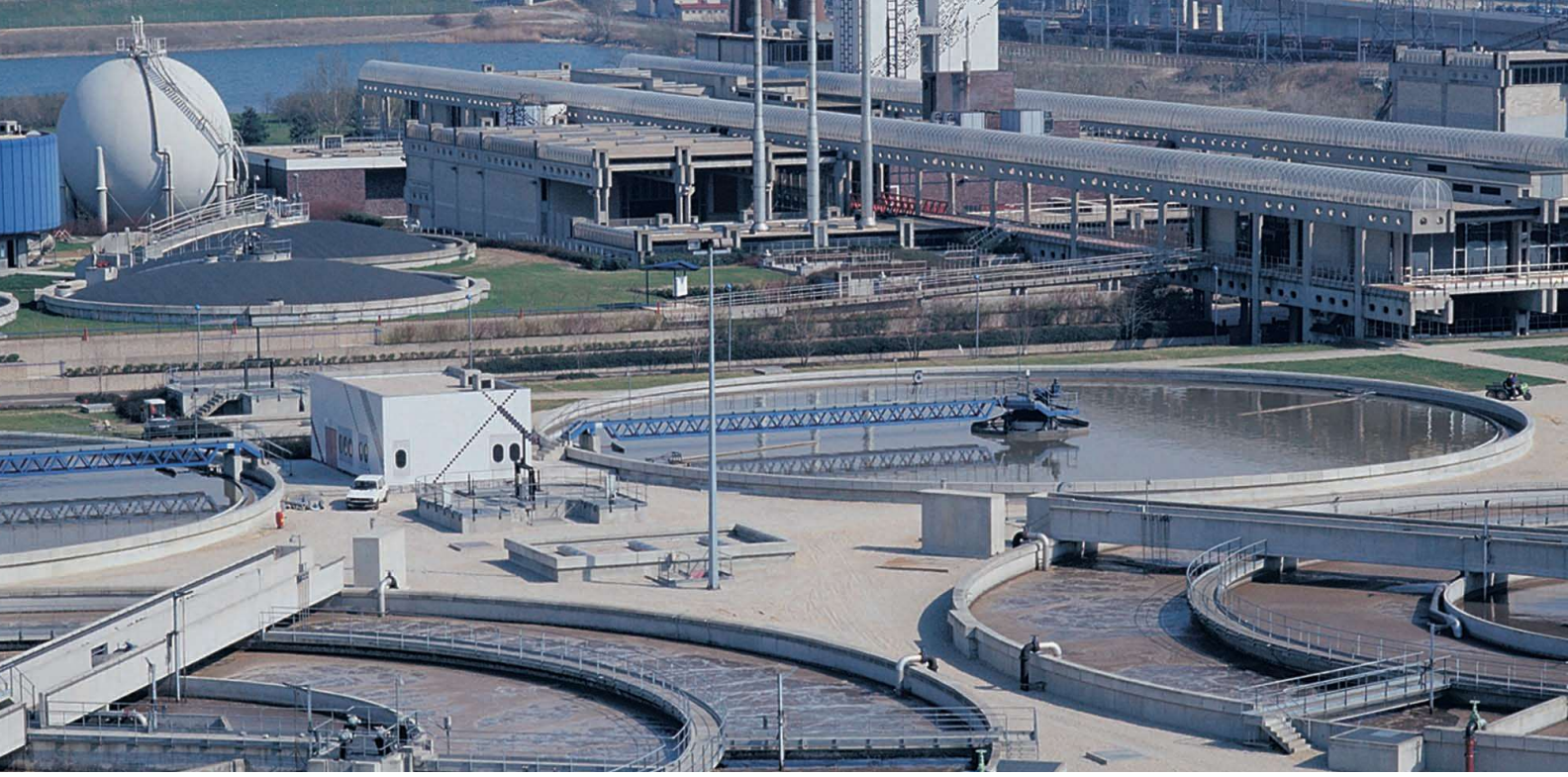
Marilynn Robinson is a vice president for MWH. Robinson joined MWH in 2000 and leads a team of management consultants and technology experts dedicated to optimizing people, processes, and systems for clients. She has a degree in civil engineering from Texas A&M University. Robinson is based in Broomfield, CO.



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Ground Gains: Unlocking Additional Water Supplies

Groundwater supplies can be plenty, but are plenty contaminated – giving rise to new technology.

By Jess Bown and Chris Cleveland

Water scarcity in the United States is a long-standing issue in the American West. Aggressive conservation programs have helped, but are frequently not enough by themselves to solve the continued pressure brought on by increasing populations, limited additional surface water supplies, and increasing regulations. With few additional surface water options, communities often look to prevalent groundwater supplies that have previously been avoided due to water-quality issues and limited, expensive treatment options. Water scarcity is not just a western issue anymore, and new solutions are needed to address this issue across the country.

Widespread Groundwater Contamination

Nitrate is a prevalent groundwater contaminant across the United States, with approximately 57% of all domestic groundwater wells affected, according to data from the U.S. Environmental Protection Agency.[1] Currently, ion exchange (IX) is most often used to remove nitrate from drinking water. A 2006 U.S. Geological Survey study showed that volatile organic compounds (VOCs) join nitrate as some of the most common groundwater contaminants. Sixty percent of the 932 wells they tested were contaminated with various VOCs such as perchloroethylene (PCE), trichloroethylene (TCE), and dibromochloropropane (DBCP).[1] VOCs are typically removed from drinking water through adsorption onto liquid-phase granular activated carbon (GAC) or through volatilization across air stripping towers. Volatilized VOCs are then scrubbed from the discharge gas using air-phase GAC. Reverse osmosis (RO) can also be implemented to remove nitrate, VOCs, and other dissolved contaminants from water.

Addressing Treatment Limitations

A critical limitation of IX, GAC, air stripping, and RO is that they each produce a contaminant-laden waste stream, sometimes highly saline, that must be further treated or disposed of. This can drive up operations and maintenance costs and, in some cases, all but eliminate treatment viability. Consequently, utilities need an efficient groundwater treatment solution that does not generate a high-strength waste stream. In response to this need, a natural treatment system, BIOTTTA™ (Biologically-Tailored, Two-Stage, Treatment Approach), has been under development over the last decade. The system uses bacteria indigenous to the local groundwater to convert contaminants like nitrate and VOCs to harmless end-products such as nitrogen gas, carbon dioxide, and water. It includes two fixed-bed bioreactors in series, each using a stationary bed of GAC, on which bacteria form robust biofilms. Raw water is amended with nutrients and is pumped across the anoxic, biologically active media bed. After first-stage biological treatment, the water is reoxygenated, dosed with a particle-conditioning agent, and treated across an aerobic biofilter that provides oxidizing and filtration capacity. Occasionally, the fixed-bed bioreactors are taken offline for backwashing. Backwash wastewater can be treated to remove solids (i.e., sloughed bacteria), which can be discharged to a sewer or land-applied, depending on the location.

The Groundwater Treatment Future Is Now

Over the past 20 years, new surface water treatment tools such as ozone, membranes, and UV have been developed to help meet water quality challenges of poorer quality sources. However, few new tools have emerged to meet groundwater treatment challenges over that time. This has left many groundwater supplies untapped due to infeasible treatment needs, challenging brine disposal options, or unreasonable costs using previous treatment approaches. For utilities seeking to combat water scarcity with previously unusable groundwater supplies, this new system is a tool worthy of investigation. BIOTTTA™ provides a new treatment technique that treats multiple contaminants, eliminates challenging brine disposal issues, and is cost-effective for water suppliers to implement. Such systems represent a new option for utilities looking for answers to water scarcity, and the key to open a once-locked water supply. ■

1. EPA Groundwater Information Sheet — Nitrate/Nitrite, Clean Water Programs, 2002; USGS Circular 1292 — Volatile Organic Compounds in the Nations' Groundwater and Drinking-Water Supply Wells, 2006.

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Innovative Financing: The Creation Of The West Coast Infrastructure Exchange

West Coast partners 'raise their game' by increasing funding for water infrastructure.

By Mike Matichich

State and local governments throughout North America are finding their ability to finance infrastructure through traditional municipal bond markets increasingly constrained as a result of both reduced public budgets and market conditions. This capacity restriction comes at a time when demand for new infrastructure and for infrastructure improvement and innovation is increasing.

Estimates of the 30-year infrastructure investment need for three West Coast states and British Columbia easily top $1 trillion.[1] Water projects alone are expected to cost, according to the American Society of Civil Engineers:

- an extra $4.6 billion a year in California (2012 data);
- an extra $2.8 billion over the next 20 years in Oregon (2009 data);
- an extra $6.7 billion over the next 20 years in Washington (2009 data);

The "Infrastructure Acceleration Layer Cake" shows how regional exchanges such as WCX can play a pivotal role in driving national infrastructure renewal.

A New Model Emerges

These dynamics — the escalating need for infrastructure and constrained public budgets — mean that states need to look at new models to deliver infrastructure projects. A new initiative, the West Coast Infrastructure Exchange (WCX) was created to do just that — bridge this funding gap by helping West Coast states and British Columbia explore alternative funding methods, including the potential to use private capital to finance critical infrastructure projects. New York-based Rockefeller Foundation provided start-up grants worth $750,000 to the Oregon State Treasury to get the Exchange up and running.

A formal announcement of the formation of the WCX, including release of a CH2M HILL study on the initiative, took place on November 14, 2012, where the governor of Oregon, John Kitzhaber said, "To build a 21st century infrastructure, we'll need to raise our game. Innovative partnerships like the West Coast Exchange can help us do that by overcoming financial, regulatory, and political hurdles and facilitating investment in long-term, job-creating projects."

No projects have yet been selected, but the WCX is laying the groundwork to identify and select a first wave of projects for investment. During this start-up phase, a WCX manager will be recruited and participating governments will work together to define the framework for the evaluation of candidate projects.

Defining Objectives

The participants' goal is to develop an innovative infrastructure financing system that provides cost savings and better collaboration, and ultimately makes projects more successful by helping to broker connections between public projects and private sources of capital. Some examples CH2M HILL identified in its report on how the WCX could achieve its objectives include:

- Bundle similar projects together, which would allow for streamlining of term sheets and allow smaller projects to qualify for different financing options.
- Manage projects more efficiently through "performance-based" partnerships.
- Facilitate collaboration between government officials, industry experts, and innovators.
- Collect data and make expertise available to governments that may have little experience designing and financing projects.

"The WCX, operating as a multi-jurisdictional forum to bring public project proponents together with private investors, is explicitly designed to help reduce overall infrastruc-

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ture costs and project risks," according to David Knowles, who serves as CH2M HILL's project manager for the WCX engagement. "Through sound management practices, aggregation of similar projects, partnering with innovators in other regions, and promoting standardization, the WCX will play a critical intermediary role as a connector and match-maker between public entities and private capital."

Around the world, alternative models of project development and finance now provide examples for West Coast jurisdictions to explore and adapt to their circumstances. The traditional approach, where a public jurisdiction develops a detailed design and then awards a construction contract to the low bidder, does not always deliver the best value to customers. Performance contracts with private entities that design, build, operate, and sometimes finance facilities, can provide better value and less risk for the public. With growing interest among large investors in infrastructure as an asset class and growing evidence of better value for a dollar in other parts of the world, these public-private approaches deserve a close look.

"Our report found that a collaborative mechanism such as the West Coast Exchange would help address the region's infrastructure needs and that there are promising private investment and delivery models employed more extensively internationally that could help fill the gap," said Knowles.

Overcoming Challenges

However, the challenge in connecting infrastructure projects with institutional and impact investors in the United States is three-fold. First, there is widespread investor belief that bureaucratic delays and environmental review requirements plague domestic public infrastructure projects, making governments unreliable partners. Investors are looking for predictable deal flow for viable projects — those that are defined, buildable, and feasible with policy level support and environmental approvals in place or pending. Second, the U.S. market lacks a transparent and objective method for vetting infrastructure projects in a manner that reveals the full range of costs and benefits of financing delivery options, a framework that considers the financial performance plus the risk transfers that occur under various financing/delivery options. Third, the use of private capital, ranging from private equity groups to pension funds and specialized impact investment funds, faces persistent political challenges resulting from,

among other things, the lack of a broad understanding of the benefits and drawbacks of privately financed projects.

Fortunately, the WCX has identified a strategic action plan to overcome these challenges. By developing a database of projects and an evaluation framework that levels the playing field for financing/delivery options, the WCX will guide the debate beyond simplistic discussions over challenges about "privatizing" towards new "performance-based" but public infrastructure. At the same time, the experience of other countries has shown that an organization like the WCX could offer the West Coast states a real opportunity to address the infrastructure service delivery challenge.

The WCX is changing the dialogue now to help inform, transform, and facilitate the finance of infrastructure projects. The WCX will help address the challenge of a shortfall in public project finance by clearing the path for impact investors in search of infrastructure opportunities generating competitive rates of return. The WCX will also work with state and local governments to enhance their capacity in risk management, project vetting, and project finance. In time, the WCX will also act as a consolidator of information and policy regarding performance-based contracting and provide technical assistance to public entities interested in procuring projects through alternative contracting.

According to Knowles, "This new approach to infrastructure financing will result in an important shift by state and local government from a reflexive commitment to status quo financing mechanisms, project types, and sources of repayment. By investing in the development of research and analysis to comprehensively document the market potential for this change and identify productive pathways that protect public benefit, stakeholders will have the information necessary to support a move towards high-performance infrastructure investments." ■

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1. American Society of Civil Engineers, State Report Card 2009

More information about the WCX, including examples of innovative projects, the CH2M HILL study, and the formal WCX agreement is available at www.westcoastx.org.

The Scan-Watch-Action Approach To Emerging Contaminants

Like water utilities, the Department of Defense keeps a close eye on emerging contaminants; here's how they do it.

By Erica Brown and Andrew Rak

Emerging contaminants (ECs) are among the many issues the water community tracks with great interest. Stakeholders — water agencies, research organizations, associations, laboratories, and interested community members — monitor legislative and regulatory initiatives, factor in public perception, and develop methods for risk communication. Water utilities often consider strategic risk management investments that reduce the potential for adverse health effects while allowing for the continued provision of a quality product and service. Advance notice of pending requirements enables these stakeholders to make the correct strategic investments to mitigate risk.

This concept of strategic risk management is precisely what the Department of Defense (DoD) is implementing with its EC program. The program was initiated in 2006 to be a proactive, over-the-horizon early warning system. The program is operated by personnel within DoD's Environmental Readiness and Safety Directorate with contractor and staff support from the U.S. Army Public Health Command, Institute for Public Health.

As defined by the DoD, ECs are chemicals or materials with pathways to the environment that present actual or potentially unacceptable human health or environmental risks. ECs either do not have regulatory peer-reviewed human health standards or have standards or regulations that are evolving due to new science, detection capabilities, or pathways. This definition was developed cooperatively with the states and U.S. Environmental Protection Agency (EPA) as part of an Environmental Council of the States working group.

This article describes a program to identify, assess, and manage ECs, and discusses ECs that are of interest to DoD and the water community.

The Process: Scan-Watch-Action

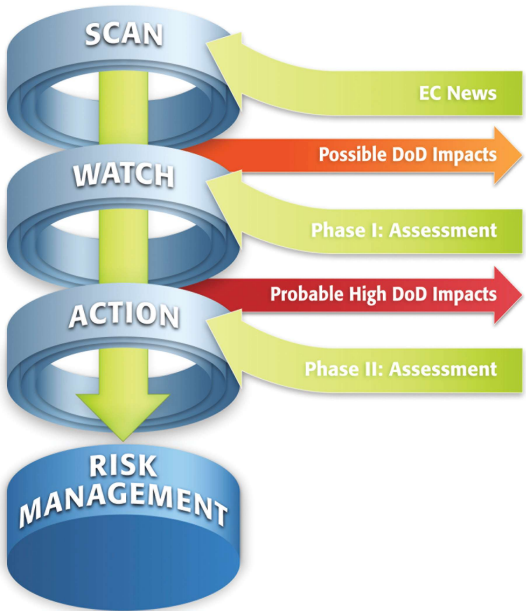
A three-step process, labeled Scan-Watch-Action (Figure 1), was developed to identify, assess, and manage potentially problematic ECs. Impact is examined in five functional areas:

- Environment, Safety, and Health (ESH)
- Training and Readiness
- Acquisition/Research, Development, Testing, and Evaluation (A/RDT&E)
- Production, Operation, Maintenance, and Disposal (POMD) of assets (facilities, equipment, platforms, and systems)
- Cleanup Program

The Scan step encompasses three ongoing components: screening, scanning, and monitoring. This step screens ECs to identify those with potential negative impacts. Scanning and monitoring include ongoing examinations of the scientific literature, regulatory communications and publications, and industry/trade press articles to identify new contaminants of interest and monitor ECs previously identified by the program. Chemicals that are regulated internationally are also scanned. A monthly report is published as an update on the contaminants being monitored.

ECs identified as possibly of concern enter into the next step as "Watch List" candidates. Candidate ECs are reviewed and approved by the Emerging Contaminants Steering Committee, a working group of qualified service representatives. Once a chemical is officially added to the Watch List, a Phase I Impact Assessment is conducted to qualitatively assess the potential impact of regulatory/policy changes (i.e.,

Figure 1. Risk management of emerging contaminants: Scan-Watch-Action



identify triggers) for a specific EC to the five DoD functional areas. The Phase I Impact Assessment process consists of three primary activities:

- Verify triggers and assess the likelihood of regulatory/policy/toxicity value change.
- Develop background data on the EC.
- Consult with subject matter experts (SMEs) to integrate the information developed in the first two activities and evaluate the risks the EC poses.

During the Phase I Impact Assessment process, SMEs with qualifications and knowledge of the EC meet to estimate the risk it poses (in terms of probability and severity) to each of the five functional areas. The results and recommendations from the assessment are documented in a Phase I Impact Assessment Report, which includes a description of the primary risk trigger or triggers (e.g., pending health criteria assessment or an agency rule under development).

The Phase I Impact Assessment produces one of the following three recommendations:

- Low risk – Remove the EC from the Watch List.
- Unclear risk – Keep the EC on the Watch List for continued monitoring and future re-assessment.
- Elevated risk – Place the EC on the Action List for further analysis.

If it is determined that the EC poses an elevated risk, it is presented to DoD Senior Leaders for approval to be placed on the "Action List."

Once approved, a Phase II Impact Assessment is performed. The Phase II Impact Assessment has three objectives:

- Verify, update, and validate the risks identified in the Phase I Impact Assessment associated with past, present, and future use of the EC, and/or items or materials that contain the EC.
- Describe in qualitative and quantitative terms the adverse impacts associated with these risks.
- Develop, score, and rank risk management options (RMOs) to address medium and high risks.

RMOs can include research projects, guidance development, and communication and coordination within the DoD Services or with other agencies. RMOs are presented to Senior Leaders for approval and, once endorsed, become Risk Management Actions (RMAs).

The Process in Practice – Ties to Water

So what does the Scan-Watch-Action process look like in practice? Many ECs enter into the process through the Scan step because of potential drinking water regulations or water quality criteria revisions. Of the 30 ECs that have been through the Phase I Impact Assessment, several were identified as contaminants of concern within the water community, including beryllium, hexavalent chromium, lead, nanomaterials, nickel, NDMA (N-nitrosodimethylamine), PFOS (perfluorooctane sulfonate), PFOA (perfluorooctanoic acid), RDX (cyclotrimethylenetrinitramine), TCE (trichloroethylene), and vanadium. Phase II Impact Assessments have been conducted for beryllium, hexavalent chromium, lead, perchlorate, PFOA, RDX, and TCE. Many of these have also been on EPA's drinking water Contaminant Candidate Lists. However, the subsequent risks identified to the DoD mission during the Phase I and/or Phase II Impact Assessments are often occupational or environmental risks that do not necessarily directly reflect water-related regulatory concerns.

Similar to planning timelines for public and private water agencies, DoD's risk management strategies and investments must be responsive to potential public-health or mission concerns.

Conclusion

Similar to planning timelines for public and private water agencies, DoD's risk management strategies and investments must be responsive to potential public-health or mission concerns. As a result, risk management options and actions are often accounted for in requirements planning and timelines that are well ahead of regulatory actions.

The EC program is continually identifying new contaminants and moving others through the second and third steps of the process. There will continue to be ample sources of potential contaminants for screening, including EPA's recent identification of 10,000 potential chemicals for its Endocrine Disruptor Screening Program and its forthcoming Regulatory Determinations on the Third Contaminant Candidate List. To date, 556 contaminants have been screened. Currently there are 20 contaminants on the EC Watch List and 7 on the Action List; 18 RMA's are being implemented to reduce risk from these ECs.

By implementing the Scan-Watch-Action process, the DoD identifies and manages the risks associated with ECs and mitigates potentially adverse consequences — offering a framework for water utilities to do the same. ■

As a civil engineer and manager at the Noblis Center for Sustainability, Erica Brown focuses on strategic planning and implementation for federal projects related to sustainability, homeland security, climate change, emerging contaminants, environmental health, regulatory compliance, and water policy.

Andrew Rak is a senior principal scientist for Noblis. Rak has more than 20 years of experience addressing complex environmental and public health problems. Currently, he leads Noblis' efforts to support the Office of the Deputy Under Secretary of Defense (Installations & Environment) Emerging Contaminants Program.